Phenomena of Jupiter's Satellites

Feb.	h. m.		Feb.	h. m.	
7	0 0	I. ecl. disap.	10	2 17	III. ecl. disap.
7	0 38	II. tr. egr.	10	5 11	III. ecl. reap.
7	3 8	I. occ. reap.	10	5 40	III. occ. disap.
7	22 3	I. tr. ing.	12	3 43	II. ecl. disap.
8	0 18	I. tr. egr.	13	5 23	I. tr. ing.
8	21 34	I. occ. reap.	13	22 3	III. tr. egr.

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, February 7. Outer major axis of outer ring = 45″·0; outer minor axis of outer ring = 20″·1; southern surface visible.

Feb.	h.	
7	6	Mars at greatest distance from the Sun.

Variable-Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Feb. 11,	22 19	*m*
Algol	3 0·8	40 31 N.	,, 8,	21 42	*m*
			,, 11,	18 31	*m*
λ Tauri	3 54·4	12 10 N.	,, 10,	23 51	*m*
W Virginis	13 20·2	2 47 S.	,, 8,	0 0	*M*
δ Libræ	14 54·9	8 4 S.	,, 11,	23 54	*m*
U Coronæ	15 13·6	32 4 N.	,, 13,	3 5	*m*
S Serpentis	15 16·3	14 43 N.	,, 8,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 8,	14 0	*m*
			and at intervals of	20 8	
β Lyræ	18 45·9	33 14 N.	Feb. 11,	9 30	*M*
R Lyræ	18 51·6	43 48 N.	,, 10,		*m*
δ Cephei	22 24·9	57 50 N.	,, 7,	21 30	*m*
			,, 13,	7 0	*m*

M signifies maximum; *m* minimum.

Meteors

There are no important periodical showers at this season of the year. The following are amongst the principal radiants from which meteors may be expected:—Near Capella, R.A. 75°, Decl. 44° N.; three radiants in Ursa Major, R.A. 131°, Decl. 52° N., R.A. 180°, Decl. 56° N., and R.A. 210°, Decl. 53° N.; one from Corona Borealis, R.A. 226°, Decl. 30°; near β Herculis, R.A. 260°, Decl. 0°. February 10 is a fireball date.

Stars with Remarkable Spectra

Name of Star	R.A. 1886·0 h. m. s.	Decl. 1886·0 ° ′	Type of spectrum
72 Schjellerup	6 3 49	26 2·1 N.	IV.
η Geminorum	6 8 0	22 32·4 N.	III.
μ Geminorum	6 16 3	22 37·5 N.	III.
78 Schjellerup	6 28 42	38 32·2 N.	IV.
LL 13412	6 49 12	23 46·8 S.	Bright lines
51 Geminorum	7 6 49	16 21·2 N.	III.
115 Schjellerup	8 48 57	17 39·9 N.	IV.
120 Schjellerup	9 3 46	31 25·7 N.	III.
R Leo Minor	9 38 45	35 2·1 N.	III.
R Leonis	9 41 26	11 57·5 N.	III.

BIOLOGICAL NOTES

METAMORPHOSIS IN NEMATODES.—Dr. von Linstow sums up our present knowledge as follows:—The Nematelminthes, according to the medium in which the individual developmental stage is passed, present a truly wonderful series of metamorphoses, and no less than fourteen distinct developmental stages may be enumerated. (1) The embryo passes into an adult form direct (without the intervention of a larval stage) in the one medium, and also passes its existence in fresh, salt, or brackish water, in plants, in the earth, or in decaying substances (Dorylaimus, Enoplus, Plectus, Monhystera, Rhabditis, and many other genera). (2) The larvæ live in the earth, the adult form in plants (*Tylenchus tritici*, *T. putrefaciens*, *Heterodera schachtii*). (3) The larvæ live in worms, and on their death and decay pass into the earth, when they assume an adult form (*Rhabditis pellio*). (4) The Helminth lives bisexual in the earth, the fruitful females enter the bodies of bees, and produce therein offspring (*Sphærularia bombi*). (5) The larvæ live in the earth, assuming the adult condition in some animal (Dochmius, Strongylus). (6) The Helminth lives as an hermaphrodite form in some animal, the offspring develop into bisexual forms in the earth (Rhabdonema, Angiostomum). (7) Some adult forms differentiate free-living forms developing sexually, and also hermaphrodite forms living parasitically in animals (snails, *Leptodera appendiculata*). (8) The larvæ hatch out in the earth, and then enter some animal, in which they become metamorphosed into hermaphrodite forms (Trichocephalus, Oxyuris). (9) The larvæ live in insects, the adult form in earth or water (Mermis). (10) The larvæ live encapsuled in some animal, and with it pass into the digestive system of some other animal form, in which latter they become adult (Ascaris, Filaria, Cucullanius). (11) For a short time the hermaphrodite form lives in the intestine of some animal, and produces here its larval form, which, penetrating the intestinal walls, makes its way into the muscles, where it becomes encapsuled (*Trichina spiralis*). (12) The adult form lives in the tracheæ of birds; the females lay eggs, which contain well-formed embryos, which get expectorated, to once again enter the bird's system with its ordinary nourishment. In the crop and œsophagus of the bird the embryo hatches out, wandering into the bronchiæ and air-sacs, from whence the larger larvæ find their way to the tracheæ (*Syngamus trachealis*). (13) There will be two larval forms, of which the one will be found in Mollusca, and the other in aquatic beetles and water-boatmen, while the adult form lives in water (*Gordius aquaticus*). (14) There will be two larval forms, of which the one will be found in water, the other in the lung of some Amphibian, from whence it will wander into the intestine of the same animal, where it will develop into an hermaphrodite form (*Nematoxys longicauda*); this latter form is described and figured.—(*Zeitschrift für wissenschaftliche Zoologie*, November 24, 1885, Band xlii. Heft 4, p. 715, pl. 28.)

ARTIFICIAL PROPAGATION OF OYSTERS.—Mr. W. K. Brooks calls attention in detail to a very important fact in the artificial propagation of oysters to which his notice was first called by Mr. W. Armstrong, of Hampton, Virginia. It would appear that "seed" oysters which Mr. Armstrong had placed on "floating-cars" in the mouth of Hampton Creek not only grew more rapidly, but were of a better shape, and therefore more marketable, than those from seed deposited at the same time in the usual way on the bottom. Immediately after the embryo oyster acquires its locomotor cilia there is a period of several hours, when it swims at the surface, and this is the period when it is swept into contact with collectors. As soon as the shell appears, the larva is dragged down by its weight, and settles at the bottom. The greatest danger to which it is now exposed is that it may not at this stage of its existence find a hard, clean surface for attachment. Being of microscopical dimensions, it may be smothered by a deposit of sediment or mud so light as to be invisible, and most of the failures to get a good "set of spat" are due to the formation of a coat of sediment upon the collectors *before* the young oysters come into contact with them. This danger seems to be entirely avoided by the use of floating collectors, for little sediment can fall on a body which is close to the surface of the water, and most of what may fall will be swept off by the currents which bring the swimming embryo oysters into the collectors. The collector employed by Mr. W. K. Brooks was formed by connecting two old ship-masts together by string pieces, with a bottom of coarse galvanised iron netting which had buoyancy enough to support a large quantity of submerged shells. Such floats should be open at the ends to permit free circulation, and should be so moored as to sway with the current. Mr. Brooks moored a collector, on July 4, in front of the Zoological Laboratory at Beaufort, N.C. Although all the oysters in the vicinity, from being in very shallow water, were nearly through their spawning season, and the conditions were anything but favourable, yet there was immediately secured a good "set," and the young oysters grew with remarkable rapidity, no doubt on account of the abundant supplies of food and fresh water, which gained ready access to all of them, and the uniform temperature which was secured by the constant change of water. The importance of this suggestion is obvious: this method may be used by planters to collect their own supply of seed—an object of great importance—when the feeding regions are far removed from native beds. Perhaps time will prove that it may be also used for rearing the oyster to a stage making it fit for the market; when, if so, the better shape and firmer shell would give the supply thus raised a superior value. Even in places where there are no oysters near to furnish the supply of eggs, a few spawning-oysters could be placed among the shells in the collector, after the French method, to supply the "set." Though, as Mr. W. K. Brooks says, "Engagement in business projects is no part of the [direct] office of a University," still, we venture to hold

that all advance in scientific knowledge has a bearing on the "business" life of a country, and we believe that these hints, based on the practical experience acquired at the Chesapeake Zoological Laboratory, will not be without value as showing what the man of science may do for the man of business.—(*Johns Hopkins University Circulars*, vol. v., No. 43, p. 10, Baltimore, October 1885.)

REPORT OF THE SUPERINTENDENT OF THE U.S. NAVAL OBSERVATORY[1]

WE make the following extracts from this important Report:—

Rear-Admiral S. R. Franklin, U.S.N., continued in the duties of Superintendent until March 31 of the current year, when he was detached therefrom in order to assume command of the United States naval force on the European station. In the interim from that date until June 1, 1885, Commander A. D. Brown, U.S.N., acted as Superintendent, when, under the orders of the Department, Commodore Belknap assumed the duties of the office.

The 26-inch Equatorial.—This telescope has continued in charge of Prof. A. Hall, U.S.N., who has been employed in observing the satellites of the large planets and in observation of double stars.

Though in constant use, the instrument, together with its micrometer, driving clock, and other apparatus, remains in good working order, and the dome, forty-three feet in diameter, covering it, is now revolved with great ease by means of the four horse-power gas-engine which was connected with it in the latter part of 1884. The dome is now turned to any position required in a few minutes, and the work of observing is much facilitated. Mr. George Anderson has charge of the engine, and assists Prof. Hall in the management of the dome.

The complete reduction and discussion of the observations made with this instrument have made good progress during the past year. This is due, in a great measure, to the efficient aid rendered by Lieut. W. H. Allen and Ensign J. A. Hoogewerff, U.S.N. These gentlemen have been very diligent in making the necessary computations, and have shown marked aptitude for the work.

The observations of the satellite of Neptune and those of the two outer satellites of Uranus have been discussed, and the masses of these planets deduced. These results have been published in Appendixes I. and II. of the annual volume of the Observatory for the year 1881.

A discussion of all the observations of Iapetus, the outer satellite of Saturn, is now nearly finished, and will be ready for printing in a few weeks. . . .

The Prime Vertical Instrument.—The work of reducing the observations made in 1883-84 by Lieut. C. G. Bowman and Ensign H. Taylor, U.S.N., for the determination of the constant of aberration, has been pursued. A selection was made of twelve stars of varying right ascension and well-determined places, and the results obtained; the reduction of the remaining observations will be proceeded with as rapidly as possible.

In July of last year a communication was received from the President of the International Geodetic Conference, asking the co-operation of this Observatory with the Royal Observatory at Lisbon in the determination of the problem of the change of latitudes, the observations to be taken with the prime vertical instruments of the two Observatories. Communication was opened and correspondence is still in progress with the Director of the Observatory at Lisbon, and preparations have be n made to undertake the work here very soon after it is known that it will be begun at Lisbon. . . .

Photography.—In the programme of work proposed for the current year it was stated that the work of taking sun photographs daily would be inaugurated as soon as practicable. The work of the Transit of Venus Commission has up to this time prevented any regular system being adopted. Such work, if pursued systematically and continuously, would put this institution on a footing in this regard more nearly equal to that of the larger foreign Observatories where a large mass of data has been accumulated for future measurement, computation, and discussion, forming the basis of much information of value to the student of solar physics.

For purposes of co-operation in this scientific work, photographic observations in different parts of the world being supplemental to each other, it is also desirable that this work be begun, and sooner or later it will have to be taken up here in order to keep pace with the requirements of modern astronomical research and observation. It cannot, therefore, be begun too soon.

It is eminently desirable that this Observatory possess a collection of photographs of astronomical subjects, and so be enabled to solicit exchanges from astronomers abroad that are engaged in celestial photography. But we lack the means and equipment for printing and making photographic positives that can properly be used for such purposes of exchange.

Much work is desirable to be done in photographing star clusters, nebulæ, and the spectra of sun-spots, stars, &c., and in the production of star maps by photography. Should a party from this Observatory be sent to observe the total eclipse of 1886, photographs of the phenomenon will have to be taken. The Observatory should at all times be prepared for such an occasion and have a staff drilled in photographic work, and this might be easily accomplished, as the number need not be great, and it could be made up of officers stationed here.

New Observatory.—The Commodore renews the recommendations of his predecessors for the removal, at an early day, of the plant of the Observatory to the new site selected and purchased for such purpose in 1881.

The plans, long since prepared, have received the approval of prominent scientific men of the country, and the work can be begun as soon as the money is forthcoming; and with the funds in hand, it would take fully three years to erect the buildings, transfer the plant, and get everything into good working order.

The National Academy has been requested by the Department to express its opinion officially as to the advisability of proceeding promptly with the erection of the building, and it cannot be doubted that it will express itself affirmatively in the matter.

The disadvantages of the present location have been so often and so forcibly described that the subject is worn almost threadbare.

To the foresight and energy of officers of the Navy is due the inception and development of this institution. It is emphatically the child of the Navy, and the service is much interested in its welfare and in every effort to extend the sphere of its usefulness. From its humble beginning in 1838 it has now grown to be one of the most important astronomical centres in the world, and it is to be hoped that Congress will recognise the good work hitherto done by granting the means to place the institution on a still higher plane than it now occupies.

Board of Visitors.—The Commodore renews the suggestion heretofore made that a Board of Visitors, composed of competent persons, be appointed annually to visit the institution and inquire into its working, with authority to suggest such changes in the methods pursued, or such new lines of investigation, as it might deem proper to recommend.

Solar Eclipse of 1886.—A total eclipse of the sun will occur on August 29, 1886. The line of totality passes over the equatorial portion of the Atlantic Ocean, and reaches the west coast of Africa, near Benguela, in latitude 12° S. This port is easy of access, and as it is the healthy season, there would be no difficulty in sending a party out in a Government vessel. The duration of the totality at this point is four minutes and forty seconds, affording a more than usually good opportunity for photographic and spectroscopic observations. The question as to the propriety of applying for an appropriation to defray the expenses of an observing party has been referred by the Department to the National Academy, and a report may soon be expected.

Miscellaneous.—During the year the names of 1408 visitors have been recorded, and 1137 permits were issued for night visitors, for whose accommodation the small equatorial is set apart. The presence of these visitors is not allowed to interfere with the regular work of the institution, and permits are only issued for one evening in each week, with exceptional instances.

The records kept by the several observers and watchmen show that only about one night in eight is good for observing, while an exceptionally good night for astronomical work cannot be reckoned upon much oftener than once a month.

[1] By G. E. Belknap, Commodore U.S.N., Superintendent United States Naval Observatory. Dated Washington, October 5, 1885

MOLECULAR PHYSICS

AT the meeting of the Berlin Physical Society, on Nov. 20 last, Herr Gerstmann spoke on a work recently issued by Prof. W. C. Wittwer, on "The Principles of Molecular Physics